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September 8, 2008

John Bunyak
Air Resources Division
National Park Service
Denver, CO 80225

Re: Comments of the American Petroleum Institute regarding the Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Revised Phase I Report; 73 *Fed. Reg.* 39039 (July 8, 2008)

Dear Mr. Bunyak,

The American Petroleum Institute (API) represents nearly 400 member companies involved in all aspects of the oil and natural gas industry. API is pleased to provide the attached comments on the revised FLAG Phase I report. In addition, API would like to formally request a public meeting, as offered in the Federal Register notice, to allow an opportunity for further discussions.

Thank you for your consideration of these comments. Please contact me at 202-682-8319 or toddm@api.org if you have any questions.

Sincerely,

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Matthew Todd

Attachment

Technical Comments Regarding the Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Phase I Report – Revised (06/27/08 Draft)

Executive Summary

The American Petroleum Institute (API) has conducted a technical review of the June 27, 2008 draft Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Phase I Report. Based on this review, API submits the following technical comments on the draft FLAG Phase I Report. API believes that these issues are critical to new oil and gas development in the west with respect to Air Quality Related Values (AQRVs) and ozone at Federal Class I areas. FLAG guidance needs to be flexible enough so that accurate analyses are conducted and any mitigation that is applied to new development as a result of air quality analyses must be technically justified, technically feasible, and cost effective.

A summary of API's comments on the FLAG Phase I Report are provided below. The technical basis for each is presented in detail in the referenced Section of this document.

Section 1.0 - General Comments.
General comments are provided regarding the overall conservatism with the proposed FLAG procedures. Federal Class II areas should not be given the same level of protection as Federal Class I areas.

Section 2.0 - FLAG and NEPA Analyses.
The Agencies have recommended FLAG procedures for NEPA analyses. FLAG procedures and significance thresholds are not applicable for NEPA analyses.

Section 3.0 - CALPUFF Model.
FLAG recommends use of the CALPUFF model for AQRV impacts. There are significant accuracy shortcomings of CALPUFF, in particular the chemistry algorithms. The FLAG procedures need to include that each CALPUFF application must be evaluated against

monitoring data to establish model bias and supporting evidence that the model is accurately predicting nitrate and sulfate formation. The use of photochemical models such as CAMx and CMAQ with state of science chemistry should be considered as alternative models in the FLAG procedures.

Section 4.0 - Meteorology Data.

FLAG recommends the use of 3-5 years of prognostic MM5 data for modeling analyses. Emphasis should be given to developing one year of accurate meteorological data for model input rather than using three to five years of prognostic data that do not accurately represent flow in the modeled region.

Section 5.0 - Visibility Thresholds.

There is no technical justification for the suggested 0.5 and 1.0 deciview "Just Noticeable Change" thresholds recommended in the FLAG report. New thresholds for "Just Noticeable Change" should be developed which include sight path.

Section 6.0 - Ozone.

The FLAG-suggested approach for ozone analyses lacks any quantitative approach, has limited technical basis, and therefore needs to be better defined in the document.

1.0 General Comments

While the FLAG procedures are a suggested ***guideline***, how and where the procedures are adopted and applied has the potential for 1) affecting industrial growth within 100 or more kilometers of a Class I Area as well as 2) defining regional air quality planning over the next 20 years. API is concerned with FLAG procedures that will likely result in compounding conservatism. In air quality analyses compounding conservatism benefits neither permit authorities, stakeholders, nor the Federal Land Managers (FLMs) because it has the potential to establish a false perception of environmental affects, which may lead to less than optimal policy and decision-making. Such practices also have the potential for misleading the public. Further, FLAG has not addressed refined modeling tools that are necessary for establishing appropriate policy, decision-making and cost-effective environmental decisions.

API is also concerned that the FLMs have concluded that Class II Areas that they manage are provided the same level of air quality protection as mandatory Class I Areas. API acknowledges that the FLMs have legal authority for managing air quality in Class II Areas but there is not justification that the same level of protection is mandated as in a Class I Area.

2.0 Purpose of FLAG and NEPA Analyses

As stated in the draft FLAG report:

> *"The purpose of FLAG is twofold: (1) to develop a more consistent and objective approach for the FLMs to evaluate air pollution effects on public AQRVs in Class I areas, including a process to identify those resources and any potential adverse impacts, and (2) to provide State permitting authorities and potential permit applicants consistency on how to assess the impacts of new and existing sources on AQRVs in Class I areas, especially in the review of Prevention of Significant Deterioration (PSD) of air quality permit application. Under the Clean Air Act, the FLM formal 'affirmative responsibility' role in the permitting process is limited to the extent a proposed new or modified source may affect AQRVs in a Class I area."*

> *"Nevertheless, the FLMs are also concerned about the resources in Class II parks and wilderness areas because they have other mandates to protect those areas as well. The information and procedures outlined in this document are generally applicable to evaluating the effect of new or modified sources on the AQRVs in both Class I and Class II areas, including the evaluation of effects as part of the review of Environmental Impacts Statements under the National Environmental Policy Act (NEPA)."*

The stated purpose of FLAG is to provide a consistent approach for evaluating air quality impacts from new or modified sources to AQRVs, the significance thresholds and analysis methodologies presented in the FLAG document are stated to be applicable to both NEPA and NSR. The FLAG guidance does not provide any distinction between NEPA and NSR and in fact the document does not discuss NEPA at all other than a footnote. In reality, because of the differences between NEPA and NSR, FLAG proscriptive methodology does not really lend itself to NEPA analyses. The following identifies the differences between NEPA and NSR:

- NEPA is a precursor to NSR and simply requires disclosure of the anticipated emissions and estimated air quality impacts from all activities associated with any development on federal land. In many cases new sources that have undergone NEPA review will need to obtain a NSR permit.
- Many NEPA projects are large-scale developments which include many sources over a large geographic region. By contrast, NSR requires permits for individual sources and facilities.
- NEPA projects typically quantify the emissions and analyze the impacts from many categories of minor sources such as construction activities and traffic emissions which would not be required for NSR permitting projects.
- The time frame of projects to be included in a NEPA analysis is very different than that under NSR. Typically, a NEPA cumulative air analysis time frame is 20 years or more. In a NSR cumulative analyses are conducted using existing sources and future anticipated sources over an 18 month time period (NSR permits expire after 18 months if the source is not built).
- In NEPA, generally no engineering data is available for many proposed new sources. For NSR, engineering data is available on emissions, location and source parameters for new sources.
- In NEPA, unlike NSR, there is no mechanism for tracking what sources are actually developed. In future years, this may lead to overstating emissions that were never constructed from prior NEPA analyses.
- Typically, in NEPA the agency that conducts the EIS analysis legally cannot impose enforceable emission limits. In essence, a NEPA analysis is a long-term regional analysis of future potential air quality over a large geographic region. By contrast, in NSR sources will have EPA and state enforceable permit emission limits.

For NEPA analyses it is appropriate to use the "best science" for estimating all project related impacts. As stated in the Bureau of Land Management (BLM) National Environmental Policy Act Handbook H-1790-1, *"Use the best available science to support NEPA analyses, and give greater consideration to peer-reviewed science and methodology over that which is not peer-*

reviewed[1]." The use of "best available science" provides the lead agency with flexibility on how NEPA analyses should be conducted.

An example of how prescriptive the nature of FLAG limits the use of "best science" is the adoption of the CALPUFF air quality model for AQRV analyses. The CALPUFF model has not been adequately tested for estimating visibility impairment and acid deposition (nitrate and sulfate formation). The chemistry modules in CALPUFF are not considered "best available science". Evaluations against monitored nitrate (NO_3) and sulfate (SO_4) concentrations have been performed using a version of the CMAQ photochemical grid model coded with the CALPUFF chemistry algorithms and the standard CMAQ model which contains a state of science chemistry module or full-science module. The version of CMAQ with the full science module clearly outperformed the version of CMAQ with CALPUFF chemistry. Therefore, for NEPA AQRV analyses, the use of photochemical grid models such as CMAQ or CAMx with state of science chemistry is appropriate and should be considered as alternative models in the FLAG document. However, the draft FLAG document fails to mention these models.

[1] "BLM National Environmental Policy Act Handbook H-1790-1 National Environmental Policy Act Program, Washington, DC, January, 2008."

3.0 CALPUFF

3.1 CALPUFF as a Tool for Assessing AQRV Impacts

The draft FLAG document proposes CALPUFF as a first-level model for calculating pollutant concentrations and assessing impacts to AQRVs (visibility and acid deposition) when sources are located more than 50 kilometers from portions of a Class I area, when an aggregation of plumes may impact an area, or when the assumptions in steady state visibility models do not apply. The FLAG document does not address other models that could be used in AQRV analysis. This is an important omission, because as we discuss below the choice of CALPUFF is not based on any relevant model performance evaluation of the Interagency Work Group on Air Quality Modeling (IWAQM)[2] recommended chemistry module (MESOPUFF II). This is a very significant procedural issue and is not consistent with EPA Model Guideline evaluation for other models. In addition, EPA has stated that because of the inability of models to accurately address the complexity of secondary aerosol formation, that when conducting such analyses, the model should be evaluated against monitoring data to estimate model bias (or accuracy) and used in a relative mode[3]. The FLAG document needs to completely revise the acceptance of CALPUFF. At a minimum, the FLMs need to state that, for each AQRV application, CALPUFF must be evaluated against monitoring data to establish model bias. Limits of acceptable performance must be included in the FLAG document. Alternatively, refined photochemical grid models (CAMx and CMAQ) should be given equal status in the FLAG document.

[2] IWAQM, 1998. Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts. EPA-454/R-98-019. Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, December 1998.

[3] EPA, 2007. Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$ and Regional Haze. Office of Air Quality Planning and Standards, Air Modeling Group. Research Triangle Park, North Carolina, April 2007.

3.2 Regulatory History of CALPUFF

In April 2003, EPA revised the Guideline on Air Quality Models to include CALPUFF as the preferred long-range transport model. At the time EPA proposed CALPUFF for inclusion into the Modeling Guideline, comments were submitted to EPA regarding the deficiencies in CALPUFF[4]. However, in the final Modeling Guideline, EPA did not address these concerns and designated CALPUFF as a guideline model.

It is important to understand how EPA originally incorporated CALPUFF into the Modeling Guideline. The following quote from 40 CFR 51 Revision to Guideline on Air Quality Models (April 15, 2003) indicates EPA's position on the use of CALPUFF**:**

> *–"…today's rule addresses the suitability of CALPUFF for PSD increment consumption and for complex wind situations (with case-by-case approval), **not AQRV analysis**."*

EPA subsequently adopted CALPUFF as the preferred model under the Regional Haze Regulations and Guidelines for Best Available Retrofit Technology (BART) Determinations; Final Rule on July 6, 2005, in which CALPUFF is recommended for determining whether a potential BART eligible source is reasonably anticipated to have a significant impacts on visibility at a Class I area, and whether the implementation of BART controls on such a source would actually improve visibility in Class I Areas.

The following presents EPA's recommendations for visibility modeling in Section 6.2.1 subparts (e) and (f) from the Revision to the Guideline on Air Quality Models dated November 9, 2005**:**

> *"CALPUFF may be applied when assessment is needed of reasonably attributable haze impairment or atmospheric deposition due to one or a small group of sources."*

[4] GTI, AQRM, 2000, Comments On EPA's Proposal To Add Several New Modeling Techniques To Appendix W Of 40 CFR Part 51

> *"Regional scale models are used by EPA to develop and evaluate national policy and assist State and location control agencies. Two such models which can be used to assess visibility impacts from source emissions are Models-3/CMAQ and REMSAD."*

Thus, the EPA Modeling Guideline which adopted CALPUFF explicitly stated that the model is not a guideline model for AQRV analyses and CALPUFF is subsequently recommended for estimating visibility impairment for EPA BART determinations.

What is important is that EPA has not developed any additional technical justification for the change in regulatory status of CALPUFF. Although the model has not been adequately tested, agencies continue to use the model in an operational mode without any type of benchmarking against reality.

3.3 EPA Model Evaluations of CALPUFF

The EPA documentation associated with CALPUFF has a very limited number of model evaluations (comparisons of model predictions to monitoring data to assess the accuracy of the model in forecasting changes in air quality). From information that was included in the EPA Docket for inclusion of CALPUFF into the Modeling Guideline, it appears that EPA evaluated the model against the Great Plains Tracer Experiment in Norman, Oklahoma and the Savannah River Laboratory Experiment in Savannah River, Georgia. In addition, an evaluation was conducted using the INEL Tracer Test. These model data comparisons showed that, to some extent, the CALPUFF model can replicate the observed data. However, there are significant limitations in these studies because they did not evaluate the CALPUFF model large dispersion distances in complex terrain nor conduct any testing of the accuracy of the CALPUFF chemistry modules. The chemistry algorithms estimate secondary sulfate (SO_4) and nitrate (NO_3) fine particle formation from sulfur dioxide (SO_2) and nitrogen oxide (NO_x) emissions. In many cases the sulfate and nitrate formed from source emissions are the primary cause of visibility impairment.

3.4 Other CALPUFF Evaluations

Beyond the EPA evaluations, there have been two other pertinent CALPUFF model evaluations performed in Wyoming and Colorado that have tested the accuracy of the CALPUFF modeling system for estimating changes in visibility. These evaluations include the Southwest Wyoming Technical Air Forum (SWWYTAF) analysis and the Mount Zirkel study.

In the SWWYTAF analysis it was found that the CALPUFF model using RIVAD Chemistry (not MESOPUFF II) could replicate observed SO_4 and NO_3 levels only with the inclusion of boundary concentrations of primary and secondary pollutants (material transported into the modeling domain)[5]. It was concluded that the majority of the secondary impacts (SO_4 and NO_3) were attributable to sources outside the modeling domain (background or boundary conditions) and that modeled sources were culpable for only about 10 percent of the total impacts. In addition, it was concluded that the formation of NO_3 was limited by ambient levels of ammonia (NH_3). Concentrations of NH_3 were back calculated using CASTNet measurements.

In the Mt. Zirkel study it was concluded that (using an early version of CALPUFF) SO_4 and NO_3 levels were generally predicted within a factor of two of observed levels without the inclusion of background or boundary conditions.

These two studies were very analogous and were performed for the same time period, in the same general area and with similar meteorological data yet reached very different conclusions.

[5]Earth Tech , Inc., 2001, The Southwest Wyoming Regional CALPUFF Air Quality Modeling Study Final Report, February, 2001.

3.5 Other Issues with CALPUFF

Another issue with the use of CALPUFF is the prescriptive modeling approach required by IWAQM that identifies how the agencies expect that CALPUFF should be run. Unfortunately, the IWAQM procedures have not been subject to any public comments or peer review outside the agencies nor included as the basis for any model evaluation to assess CALPUFF accuracy.

A limited evaluation of CALPUFF accuracy using the IWAQM approach was conducted in response to the BLM Moxa Arch EIS[6]. This evaluation focused on a limited evaluation of secondary NO_3 for each day and the reported receptor that had the highest visibility impacts for the 2005 actual inventory. The maximum **predicted** NO_3 concentration as a result of oil and gas operation in 2005 was 5.3 µg/m^3. The 2005 Bridger **monitored** NO_3 concentration data were obtained from the IMPROVE web site and the maximum measured concentration was 0.56 µg/m^3. In actuality, this was the lowest maximum NO_3 concentration at the Bridger monitoring site over the period of 1988 through 2005. This provides a strong indication that CALPUFF is substantially over predicting NO_3 concentrations at the Bridger Class I Area.

There are minor limitations to this analysis such as the lack of availability of 2005 meteorological data which therefore required the use of 2001 meteorology. As a result, it was not possible to compare specific days of model output with days that monitoring data were collected. Changes in meteorology alone are not likely to cause such a large model over prediction. A second minor limitation is that since the IMPROVE data are only collected every 3 days, high NO_3 may have occurred on days when sampling was not collected. This possibility was examined by reviewing NO_3 concentrations over the period of record (1998-2005) and the maximum NO_3 concentration was 0.82 µg/m^3 (in 2002). Clearly, as a result of this comparison there is a very strong indication that CALPUFF is substantially over predicting measured NO_3 concentrations when using IQAQM methodology. Figure 1 presents the observed and CALPUFF predicted frequency distribution. As indicated by this figure, CALPUFF is not replicating the IMPROVE monitoring data with any degree of certainty.

[6] BP America Production Company 2008, Comments on the Air Quality Analysis for Moxa Arch Draft EIS

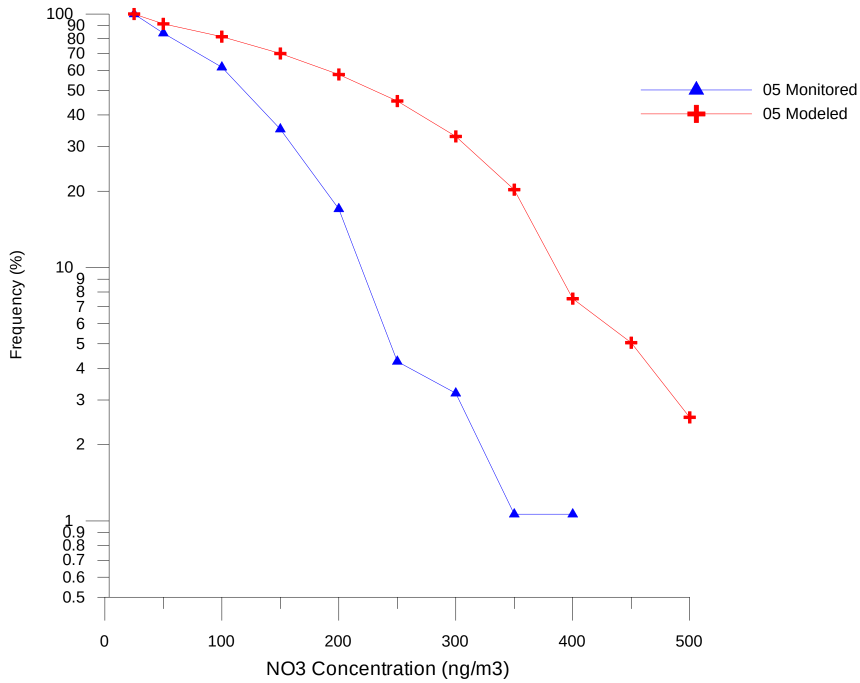


Figure 1. Cumulative Frequency Distribution for Bridger Class I Areas NO_3 Concentrations Modeled versus Monitored 1988-2005.

3.6 CALPUFF Chemistry

In recent studies, ENVIRON conducted critical reviews of the FLAG recommended MESOPUFF II chemistry module in CALPUFF[7,8]. The MESOPUFF II chemistry module estimates secondary sulfate (SO_4) and nitrate (NO_3) formation from sulfur dioxide (SO_2) and nitrogen oxide (NO_x) emissions. The MESOPUFF II chemistry module in CALPUFF is based on a very limited set of atmospheric conditions, and literally reduces thousands of chemical reactions and hundreds of species into the four equations listed below .

[7] Ralph Morris, Steven Lau and Bonyoung Koo, 2005, Evaluation of the CALPUFF Chemistry Algorithms, Presented at A&WMA 98th Annual Conference and Exhibition, June 21-25, 2005 Minneapolis, Minnesota.

[8] Ralph Morris, Steven Lau, Bonyoung Koo, Abby Hoats and Greg Yarwood 2006, Further Evaluation of the Chemistry Algorithms used in the CALPUFF Modeling System, AWMA Guideline on Air Quality Models Conference , Denver CO, 26-28 April, 2006.

1) $SO_2 \xrightarrow{k_1} SO_4$

2) $NOx \xrightarrow{k_2} HNO_3 + RNO_3$

3) $NOx \xrightarrow{k_3} HNO_3$

4) $HNO_3\,(g) \xleftrightarrow{NH_3} NO3\ (PM)$

Where, daytime rates are defined as:

$k_1 \quad = 36 \times R^{0.55} \times [O_3]^{0.71} \times S^{-1.29} + k_{1(aq)}$

$k_{1(aq)} \quad = 3 \times 10^{-8} \times RH^4$ (added to k_1 above during the day)

$k_2 \quad = 1206 \times [O_3]^{1.5} \times S^{-1.41} \times [NOx]^{-0.33}$

$k_3 \quad = 1261 \times [O_3]^{1.45} \times S^{-1.34} \times [NOx]^{-0.12}$

and nighttime rates are defined as:

k_1 = 0.20 (%/hr)

k_2 = 0.00 (%/hr)

k_3 = 2.00 (%/hr)

In the MESOPUFF II chemistry module used in CALPUFF, SO_4 formation is described by 4 variables**:**

1) Solar Radiation;
2) Background Ozone (surface, user provided);
3) Atmospheric Stability; and
4) Relative Humidity (surrogate for aqueous-phase).

NO_3 formation is described by 3 variables:

1) Background Ozone;
2) Atmospheric Stability; and
3) Plume NO_x Concentration

The ENVIRON papers cite the following theoretical limitations of CALPUFF using the MESOPUFF II chemistry module.

1) Aqueous-Phase SO_4 formation is inaccurate and is solely based on surface relative humidity (RH). In reality, aqueous-phase SO_4 formation is not at all affected by RH and this assumption is incorrect.
2) The MESOPUFF II transformation rates were developed using temperatures of 86, 68 and 50°F. The lack of temperature effects and 50°F minimum temperature used in development will overstate SO_4 and NO_3 formation under cold conditions.

Comparisons of predicted SO_4 and NO_3 formation versus measured SO_4 and NO_3 concentrations were performed for the MESOPUFF II chemistry module and a full-science chemistry module. The comparison utilized the EPA CMAQ modeling system which includes a full-science chemistry module and a version of CMAQ coded with the MESOPUFF II chemistry algorithms. Model comparisons were performed using IMPROVE and CASTNet monitoring data. Figures 2 and 3 present comparisons for summertime SO_4 formation and wintertime NO_3 formation, respectively. The blue points represent the MESOPUFF II predictions and the red points represent model predictions from CMAQ. As indicated in these figures, the MESOPUFF II chemistry module understates summertime SO_4 formation and overstates wintertime NO_3 formation where the CMAQ model, using a complete full-science chemical module, correlates better with the observations.

Figure 2. Scatter plots of predicted and observed Sulfate (SO_4) concentrations by the CMAQ V4.4 (red) and CMAQ-MESOPUFF II chemistry (left blue) for July 2002 at all IMPROVE (left) and CASTNet (right) sites in the United States.

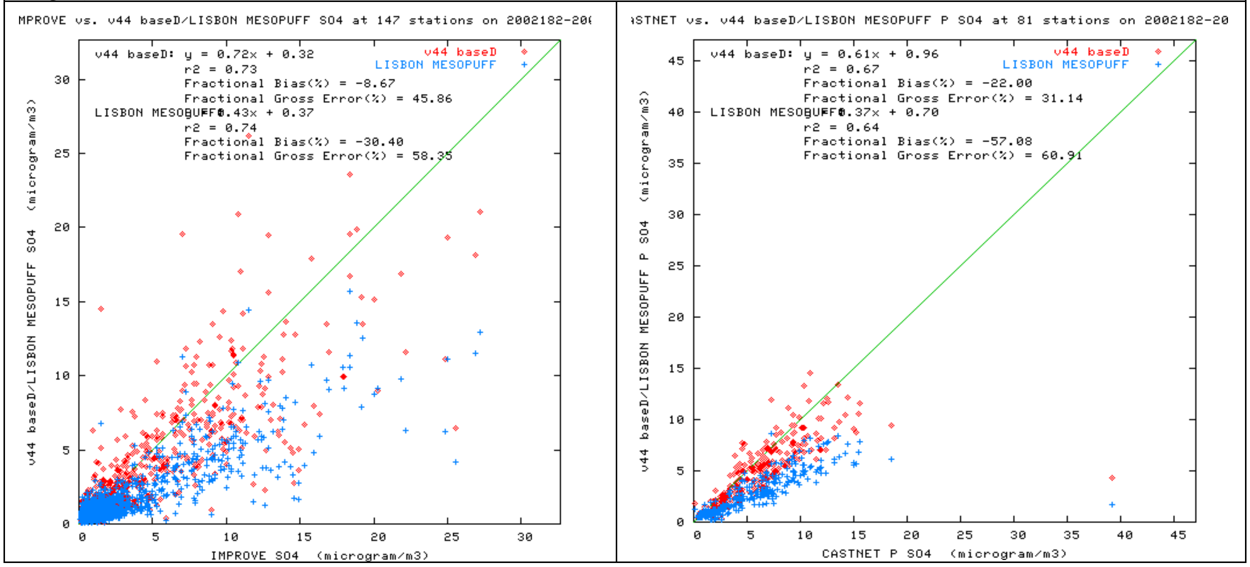
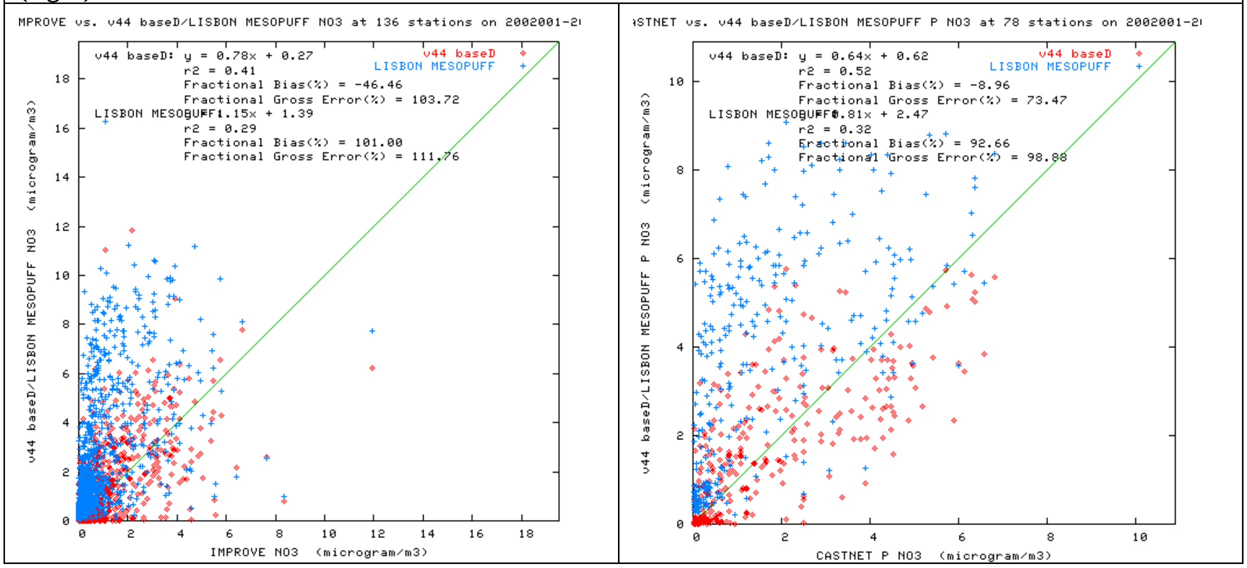


Figure 3. Scatter plots of predicted and observed Nitrate (NO_3) concentrations by the CMAQ V4.4 (red) and CMAQ-MESOPUFF-II chemistry (left blue) for January 2002 at all IMPROVE (top), and CASTNet (right) sites in the United States.



Overall, the evaluation indicated that the CALPUFF MESOPUFF II chemistry algorithms greatly overstate NO_3 formation. Sulfate formation is likely overstated in the winter and understated in the summer. Therefore, given that in many cases visibility impairment is primarily due to secondary SO_4 and NO_3 aerosols formed from SO_2 and NO_x emissions, visibility impacts using the MESOPUFF II module are greatly overstated in the winter when compared to full science chemistry modules.

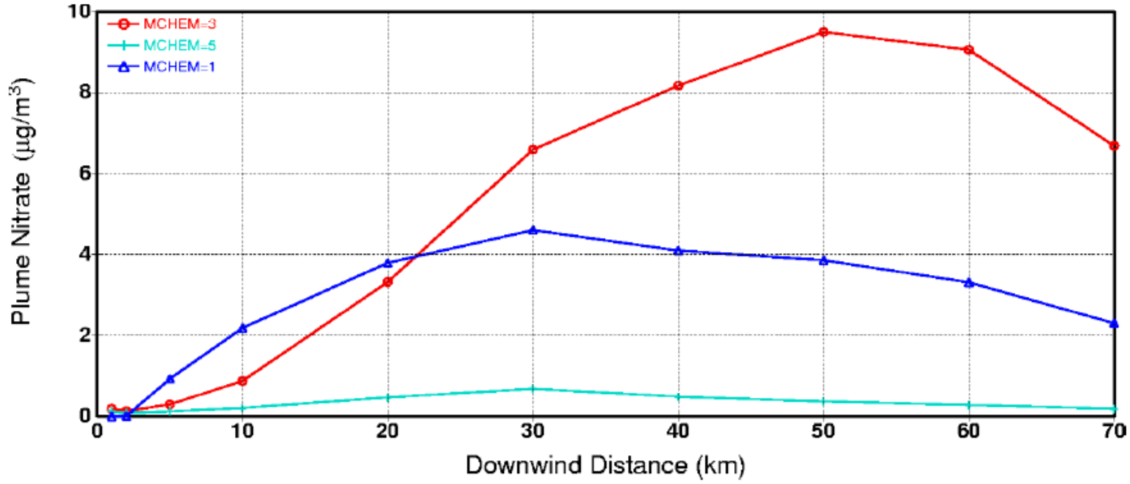
3.7 Additional Information on the Accuracy of the CALPUFF Chemistry

API has recently conducted an evaluation of the EPA CALPUFF model and, based on that review, it was concluded that there were errors in formulation of the chemistry modules of the model[9]. As part of the API study, a new version of CALPUFF has been developed which includes both corrections to errors in the existing gas-phase chemistry module, as well as incorporation of new science modules for inorganic and organic aerosols and aqueous-phase chemistry.

The changes to the chemistry algorithms in the CALPUFF model were revised to be more consistent with the state of science chemical mechanisms available in the photochemical grid models CAMx and CMAQ. Figure 4 presents a comparison of nitrate predictions from the new and previous algorithms in CALPUFF. As indicated in this figure, when the model is run using current state of science chemical formulations (consistent with CAMx and CMAQ), substantially lower NO_3 concentrations are predicted and theoretically should be more consistent with monitoring data.

[9] Prakash Karamchandani, Shu-Yun Chen and Christian Seigneur 2007, CALPUFF Chemistry Upgrade, draft report prepared by Atmospheric & Environmental Research, Inc. prepared for the American Petroleum Institute November, 2007.

Figure 4. Comparison of CALPUFF Chemistry Modules



Particulate nitrate concentrations as a function of downwind distance (relative humidity set to 95%). MCHEM=1 refers to the MESOPUFF II option, while MCHEM=3 refers to the original RIVAD treatment, and MCHEM=5 refers to the new RIVAD treatment (ISORROPIA).

API also found that, through conducting low temperature sensitivity studies, another important shortcoming of CALPUFF was identified; its lack of treatment of ammonia limitation for multiple or overlapping puffs. This finding leads to substantial overestimation of particulate nitrate formation at downwind receptors. This shortcoming could be addressed by a post-processing step to recalculate inorganic aerosol equilibrium at receptor locations. In addition, an upper limit for particulate nitrate formation that is based on the amount of ammonia available in the background should be implemented in CALPUFF to prevent the output of particulate ammonium nitrate concentrations that are physically unrealistic and **when CALPUFF does not conserve mass of ammonia** (as is the case in the current model).

A potential reason that CALPUFF is over predicting observed NO_3 concentrations is the assumed use of the IWAQM default NH_3 concentration of 1 ppb. The CALPUFF model assumes that the concentration of NH_3 is uniform over the depth of the mixed layer. This assumed NH_3 concentration of 1 ppb is in direct conflict with the modeling analysis that was done for the SWWYTAF study. One major finding of the SWWYTAF modeling verification analysis was that CALPUFF would not replicate observed NO_3 concentrations in the Bridger Class I Area using the IWAQM default NH_3 concentrations. An extensive analysis of air quality measurements in the region concluded that NO_3 formation was limited by NH_3 concentrations. Once this finding was included in the modeling along with boundary conditions, CALPUFF replicated the observed NO_3 concentrations. In subsequent analyses, ignoring this finding and using an arbitrary default value adds unnecessary conservatism to the analysis. Figure 5 illustrates the effect on predicted NO_3 concentrations based on background NH_3 concentrations.

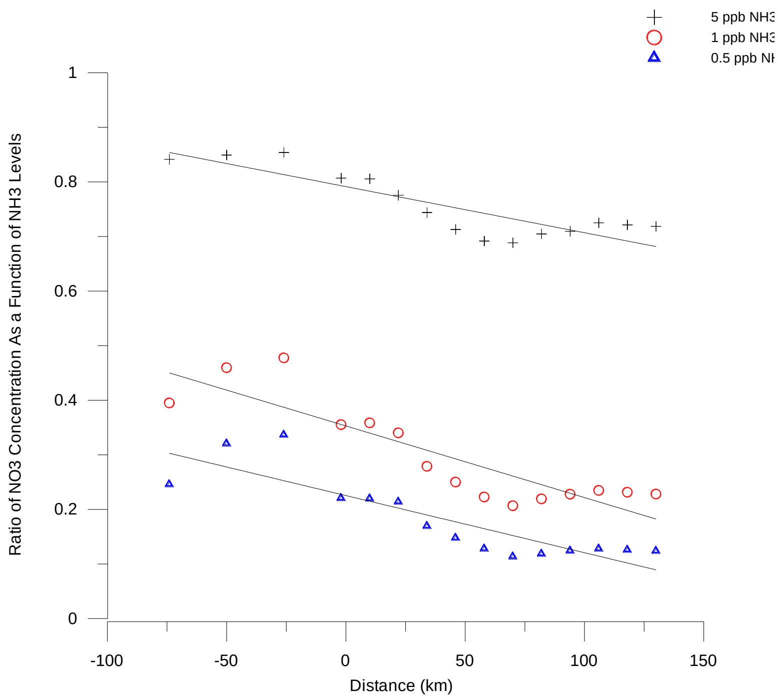


Figure 5. Comparisons of Predicted NO_3 Concentrations for Various NH_3 Levels As a Function of Distance.

As indicated by this figure, there was approximately a 60 percent difference in predicted NO_3 concentrations by changing the background concentration from 1 ppb to 0.5 ppb. The application of how NH_3 concentrations are used in CALPUFF is very conservative because the model assumes that the NH_3 concentration is uniform between the ground and plume height. In reality, this assumption is not likely to be true and NH_3 concentrations at plume height will be less than those at ground level.

As part of this analysis the estimated mass flux calculations was based on a uniform 1 ppb of NH_3 concentration throughout the mixed layer. The CALPUFF modeling was based on a 4 kilometer grid size and a modeling domain of 116 cells by 138 cells. Emission flux estimates were based on assumed wind speeds and mixing heights and were converted into an emission rate based on the size of the modeling domain. Table 1 presents regional estimates of NH_3 emissions using this approach.

It was assumed that the wind speed did not vary with height in the screening calculations and as a result this will underestimate emissions. The screening estimates were compared to NH_3 emission calculations developed by the Western Regional Air Partnership (WRAP) that indicated that emissions were at a maximum of 1 ton/day in very limited 36 kilometer grid cells and many grid cells had no NH_3 emissions. Based on the mass flux calculations, the assumption of ambient NH_3 concentrations of 1 ppb is inconsistent with the work performed by WRAP and significantly overstates the mass of NH_3 available in the region.

Table 1
NH_3 Mass Flux Calculations

Assumptions:
Assume 4 km grid square
Assume 1 ppb of NH_3 = 0.695011 µg/m^3 mw of NH_3 =17
Assume 100 meter mixing height
CALPUFF assumes a uniform NH_3 profile
This means that NH_3 concentration will be 1 ppb up to mixed height

Case 1 – 3 m/s 1000 m mixing height

Upwind face of grid square =	4,000	meters	
height of box =	1,000	meters	Average for day
Vertical area =	4,000,000	m^2	
Average wind speed (for a day)	3	m/s	at 10 meters
Flux	2.09	µg/m^2-sec	
mass rate across a grid square	8340132	µg/s	
	8.34	g/s	
	1.05	lbs/hr	
	0.0126	tons /day per grid square	
	15,776	number of grid squares	
	198.9	**Tons/day over entire modeling**	

Case 2 - 10 m/s 1000 m mixing height

Upwind face of grid square =	4,000	meters
height of box =	1,000	meters
Vertical area =	4,000,000	m^2
Average wind speed (for a day)	10	m/s
Flux	6.95	µg/m^2-sec
mass rate across a grid square	27800440	µg/s
	27.80	g/s
	3.50	lbs/hr
	0.0420	tons/day per grid square
	15,776	number of grid squares
	663.1	**Tons/day over entire modeling**

Table 1 (continued)
NH_3 Mass Flux Calculations

Case 3 - 1 m/s 100 m mixing height			
Upwind face of grid square =	4,000	meters	
height of box =	100	meters	Average for day
Vertical area =	400,000	m^2	
Average wind speed (for a day)	1	m/s at 10 meters	
Flux	0.70	$\mu g/m^2$-sec	
mass rate across a grid square	278004	µg/s	
	0.28	g/s	
	0.04	lbs/hr	
	0.0004	Tons /day per grid square	
	15,776	number of grid squares	
	6.6	**Tons/day over entire modeling**	
WRAP Calculates Approximately	1	ton per day in selected grid	
		Approximately 10 percent of the	
	49	Tons/day for the modeling domain	

Comparison of Mass Flux and WRAP

Mass Flux		WRAP	Ratio
Case 1	199	49	4.09
Case 2	663	49	13.62
Case 3	6.6	49	0.14

The NH_3 background assumption in FLAG is based on the following reference *"IWAQM refers to Langford et al. (1992), who suggest that typical (within a factor of 2) background values of NH_3 are: 10 parts per billion (ppb) for grasslands, 0.5 ppb for forest, and 1 ppb for arid lands at 20^oC. Langford et al. (1992) provide strong evidence that background levels of NH_3 show strong dependence with ambient temperature (variations of a factor of 3 or 4) and a strong dependence on the soil pH. However, given all the uncertainties in NH_3 data, IWAQM recommends use of the background levels provided above, unless better data are available for the specific modeling domain."*

Recent monitoring in Wyoming and the Four Corners region indicate that the use of 1 ppb NH_3 for modeling is inappropriate. It is recommended that a more recent analysis of background NH_3 for the intermountain west be conducted. Consideration should be given to back calculating NH_3 based on CASNet measurements.

3.8 Conclusions Regarding the Use of CALPUFF

Based on information provided in this analysis, it is inappropriate for the FLMs to adopt CALPUFF in FLAG without supporting evidence that the model is accurately predicting nitrate and sulfate formation, hence changes in visibility and deposition. If the CALPUFF model cannot accurately predict correct SO_4 and NO_3 compared to monitoring data, then it is presumptuous to believe that it can be accurately used without additional supporting documentation.

In conclusion, the FLAG procedures need to address the significant accuracy shortcomings of CALPUFF and include CAMx and CMAQ as equivalent models for AQRV analyses.

4.0 Use of MM5 Meteorological Modeling as Input to CALMET

The draft FLAG document states that 3 to 5 years of MM5 prognostic modeling should be used as input to CALMET for conducting AQRV analyses. Rather, the selection and number of years of meteorological data (or years of prognostic modeling results) that should be used in an air quality analysis needs to be a case-by-case determination based on:

1) Size of modeling domain;
2) Available on site meteorological data;
3) Accuracy of prognostic modeling results; and
4) Source type (effective plume height).

The use of prognostic modeling results as input to CALPUFF or other atmospheric dispersion models does not ensure that the model is accurately representing transport and dispersion over the study domain. There may be situations where the use of local on site meteorological monitoring data will result in more accurate wind fields than using a prognostic model.

To illustrate this point, analyses of three separate evaluations of MM5 accuracy have been conducted using independent on site meteorological data in southwestern Wyoming. These analyses examined the accuracy of MM5 on a 36, 12 and 4 kilometer grid size.

The 36 kilometer MM5 analysis was based on a 1995 MM5 model run conducted as part of the SWWYTAF air quality study[10]. The accuracy of the MM5 data was conduced separately using the MM5 modeling results[11]. The 12 kilometer MM5 analysis was conducted by ENVIRON for years 2001, 2002 and 2003, and used as input to the Moxa Arch[12] EIS analyses and an evaluation of accuracy was performed by BP in response to the Moxa Arch EIS. The 4 kilometer MM5

[10] Earth Tech , Inc., 2001, The Southwest Wyoming Regional CALPUFF Air Quality Modeling Study Final Report, February, 2001.
[11] Blewitt, D.N., J.A. Panek and W.A. Patton "Evaluation of the Accuracy of MM5/CALMET Generated Wind Fields in Southwestern Wyoming Using an Independent Data Set"
[12] Bureau of Land Management, 2007, Moxa Arch Area Infill Gas Development Project, Draft Environmental Impact Statement. U.S. Department of the Interior, Bureau of Land Management, Kemmerer Field Office, Kemmerer, WY and Wyoming State Office, Cheyenne, WY in cooperation with the State of Wyoming, Oct 2007.

analysis was conducted by ENVIRON[13] for years 2005 and 2006. The accuracy of all three of these MM5 analyses were evaluated by extracting MM5 wind speed and wind direction results for meteorological monitoring sites in southwest Wyoming. The assessment of MM5 accuracy was determined by comparing MM5 wind roses to monitored wind roses.

Figure 6 presents a map of southwest Wyoming. The Bridger Class I Area (Wind River Mountains) is north of the study area and the Salt Mountain Range is to the west. Figure 7 presents a picture of the Jonah meteorological monitoring site that was used to evaluate the accuracy of MM5.

For the 36 kilometer grid analysis, 1995 MM5 annual wind rose results were compared to 1999 annual wind rose results for the Jonah meteorological tower. Additional analyses were conducted to ensure that these years were representative of long-term averages. Figure 8 presents the comparison of MM5 modeling results and actual monitoring data.

[13] ENVIRON, 2008, Preliminary Evaluation of the CD-C Project 4 km MM5 Runs for 2005 and 2006.

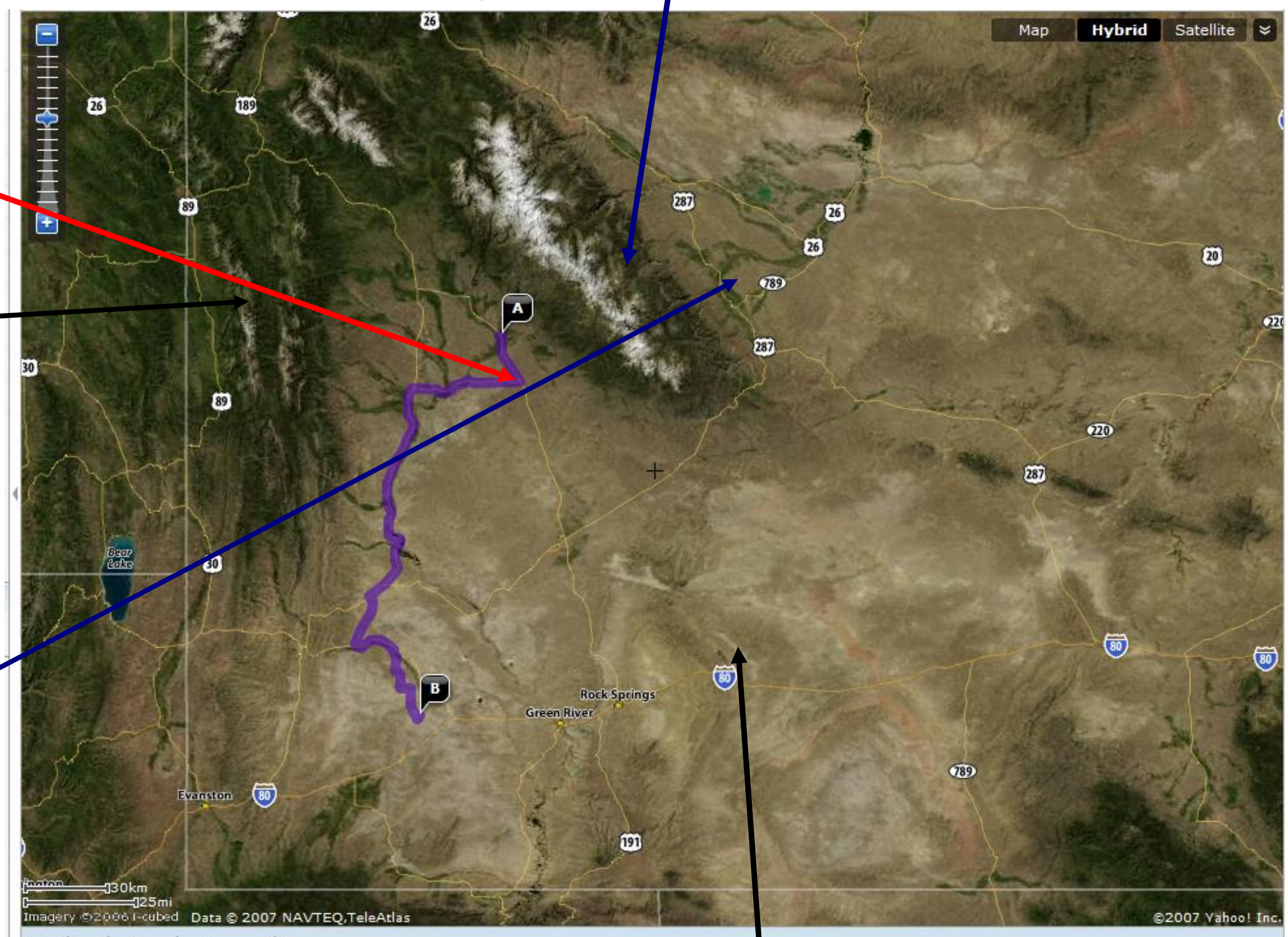
Figure 6. Wyoming Study Area

Bridger Class I Area

Jonah Met Location

Salt Mountain Range

Lander Hunt Field



Wamsutter

Figure 7. Jonah Meteorological Tower

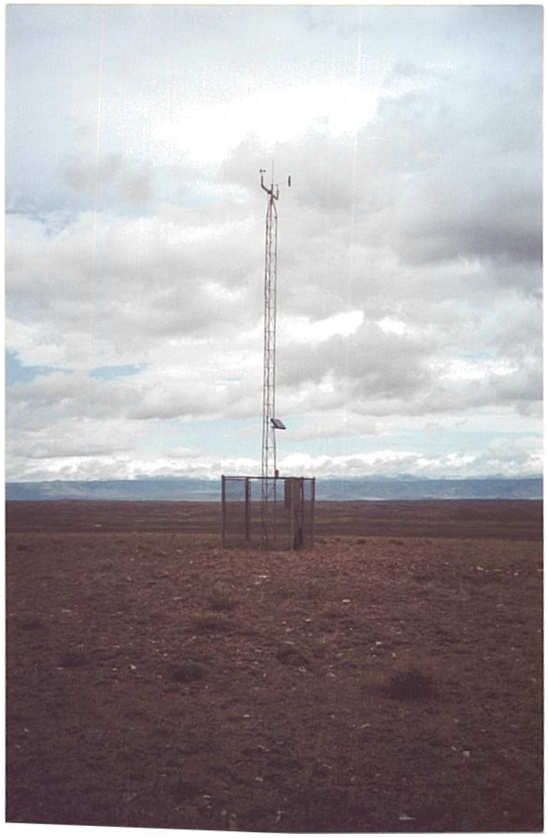
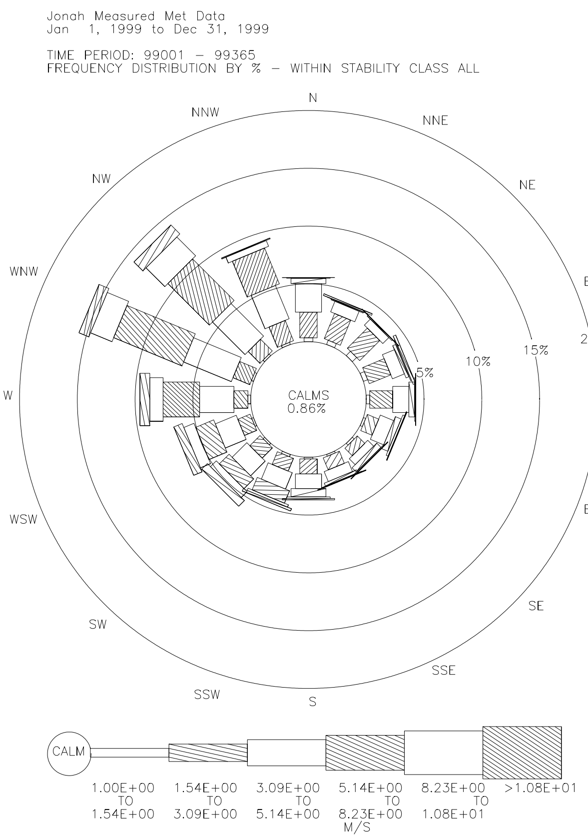
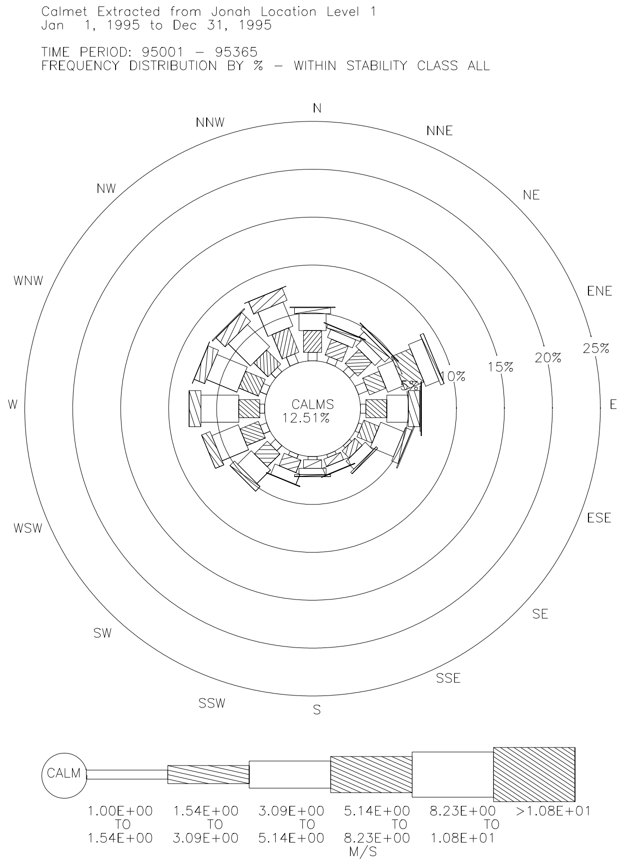


Figure 8. Comparisons of Monitored and CALMET Modeled Annual Wind Rose





These figures clearly indicate that there is a large difference between measured and modeled wind speed and direction. This inaccuracy in prognostic modeling raises concern regarding the accuracy of the developed wind fields and subsequent air quality modeling. As part of the accuracy analysis of the 1995 MM5 modeling results, model sensitivity testing indicated that using more accurate wind speeds than those estimated by MM5 had a pronounced affect on predicted NO_3 concentrations. The uncertainty in wind direction is also very important and will influence predicted concentrations.

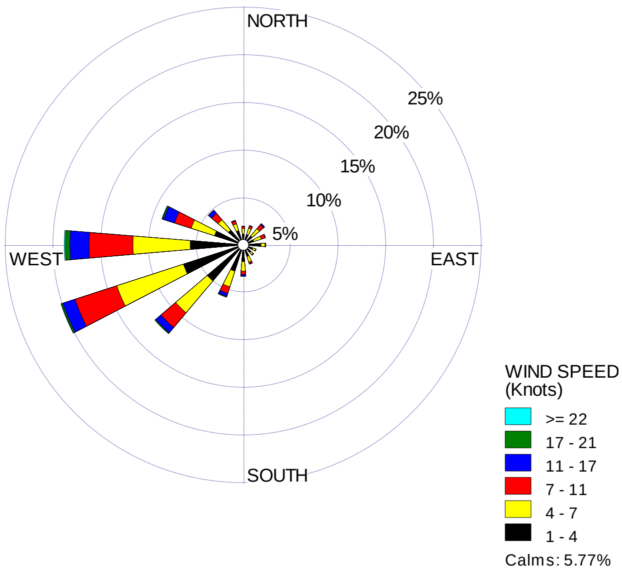
As indicated by these figures, at a 36 kilometer resolution, MM5 is not accurately predicting local meteorological conditions in the vicinity of the Jonah meteorological tower and likely throughout the entire modeling domain. Additional analyses were conducted and it was concluded that the uncertainty in meteorological modeling results was a result of MM5 and not CALMET.

Figure 9 presents a comparison of 12 kilometer MM5 results with the data collected at the Jonah meteorological tower.

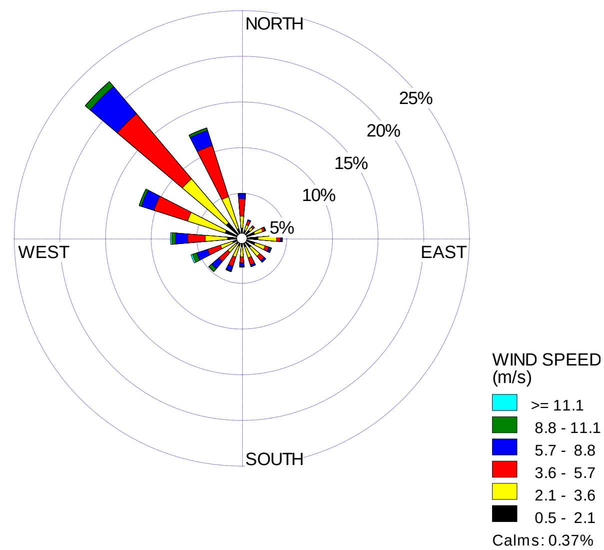
As indicated in these figures, when MM5/CALMET was run on a 12 kilometer grid, the models could not replicate the measured Jonah wind speed and direction data. In fact, the modeled wind rose appears to be more similar to the meteorological data measured at the Lander Hunt site that is located on the eastern side of the Wind River Mountains. One possible explanation for this poor performance in MM5 is that MM5 does not appear to include the influence of the Wind River Mountain Range and may be a result of averaging terrain over a 12 kilometer grid cell.

Figure 9. Measured Wind Rose from Jonah and Lander Hunt Field and CALMET/MM5 Predicted Wind Rose

CALMET/MM5 Predicted



Jonah Measured



Lander Hunt Field Measured

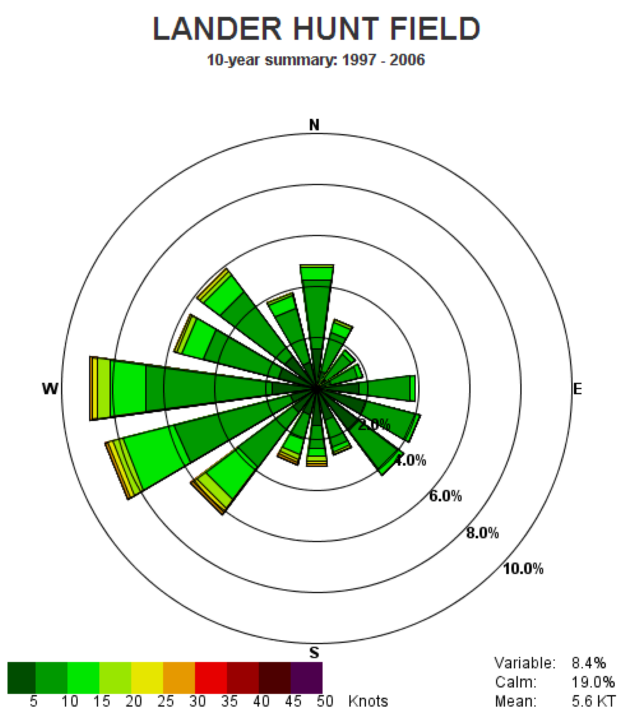


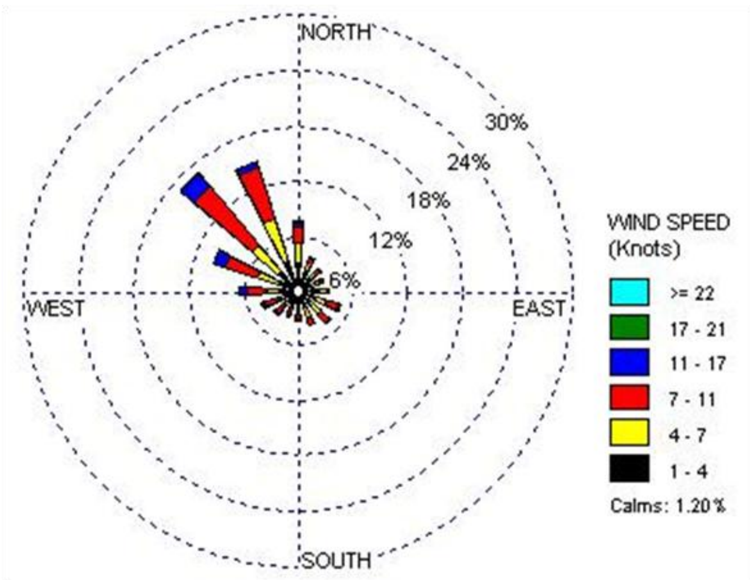
Figure 10 presents a comparison of annual wind roses for the Jonah tower and 4 kilometer MM5 modeling. Unlike the 36 and 12 kilometer modeling results, the use of this size grid does replicate the observed meteorological data collected at Jonah. However, additional, analyses of the Wamsutter meteorological tower (installed in 2005) indicates that even with the use of this small grid size, MM5 cannot replicate the measured data.

If MM5 modeling results are supplemented with local meteorological data through CALMET, unrealistic and discontinuous wind fields can be developed.

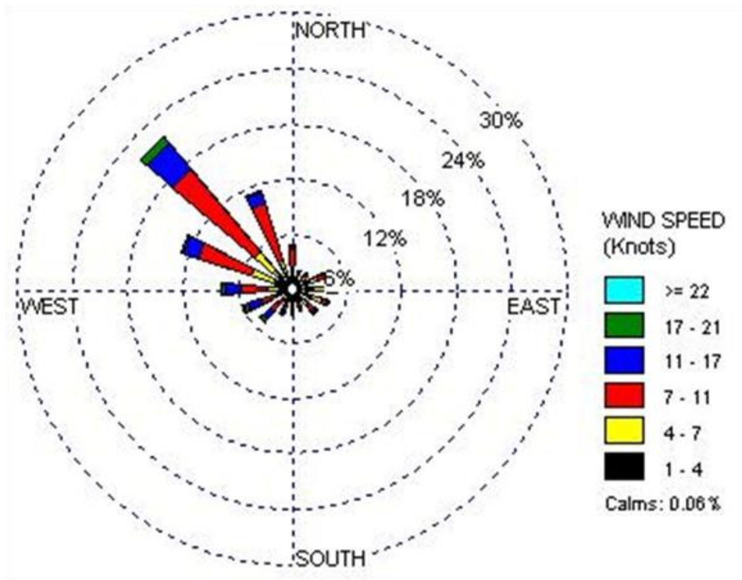
For southwestern Wyoming, this analysis indicates that MM5 is not producing accurate wind fields. It is recommended that more emphasis be given to developing one year of accurate meteorological data for model input rather than using multiple years of data that do not accurately represent flow in the region. The decision on the use of the meteorological data to be used in an AQRV analysis should be a case-by-case decision rather than prescribing the use of 3-5 years of prognostic meteorological modeling results as input to an air quality model.

Figure 10. Comparison of 4-Kilometer MM5 Model Results to Jonah Meteorological Data

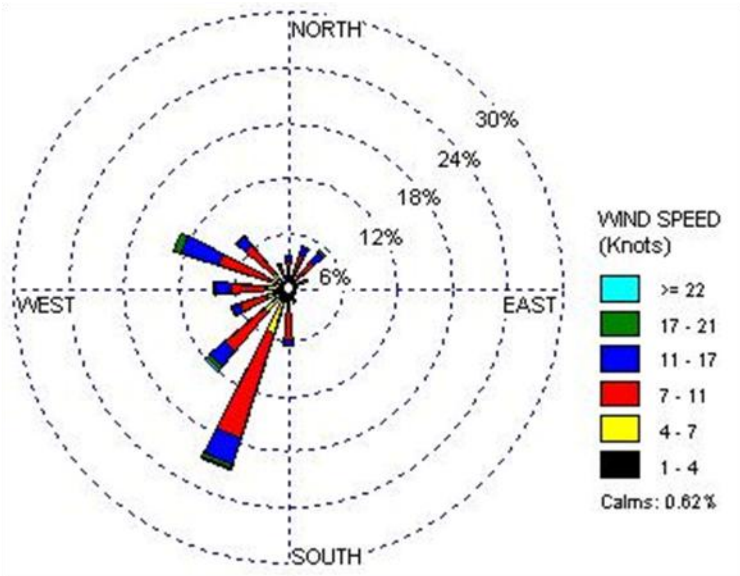
Observed Jonah



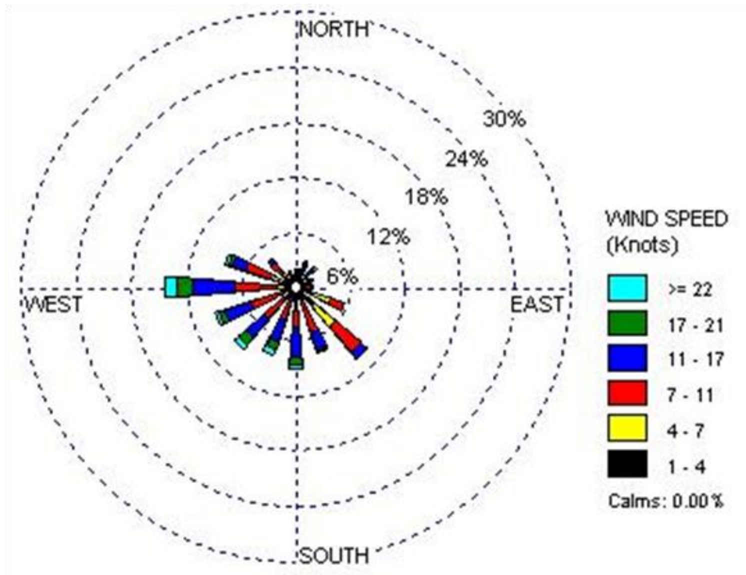
4 Kilometer MM5 Jonah



Observed Wamsutter Monitor



4 Kilometer MM5 Wamsutter



5.0 Issues with the Definition of "Just Noticeable Change"

The draft FLAG document proposes to use EPA's 2005 Best Available Retrofit Technology (BART) Guideline thresholds for regional haze; defined as "contribute" [0.5 deciview (dv) or approximately a 5% change in light extinction] and "cause" (1.0 dv or approximately a 10% change in light extinction) regarding regional haze visibility impairment. The draft FLAG document states *"The 0.5 dv and 1.0 dv thresholds are similar to what the Agencies used in FLAG 2000."* Whereas FLAG 2000 used a 0.5 dv threshold for single source analyses and a 1.0 dv threshold for multi-source analyses, in the revised FLAG document it appears that the 0.5 dv threshold is what the FLMs propose to use for a threshold for both single source and multi-source analyses. There is no technical justification provided in the draft FLAG document to support this change nor have the FLMs provided any quantitative data that supports the use of 0.5 dv as the threshold for just noticeable change.

Review of the technical literature EPA used to establish a "Just Noticeable Change (JNC)" threshold for visibility does not support the values EPA has adopted.

The following is a quote from the National Acid Precipitation Assessment Program (NAPAP) Report that EPA used in support of its definitions that illustrates the technical basis weakness of defining a change of 5 percent in light extinction as the JNC threshold in visibility:

"Given the above equations, just noticeable changes presented in this report are calculated using the following:

- *Identify all contrast edges in the photograph. This includes contrast edges between contiguous features as well as any feature outlined against the sky.*
- *Calculate the equivalent contrast between all edges using equations D-4 and D-5 as a function of the incremental changes in aerosol concentrations.*
- *When the difference between the square of initial and final contrasts are greater or equal to the right-hand side of equation D-1, a JNC has been reached.*

- *Repeat the calculation until the desired amount of aerosol has been added or subtracted from the atmosphere.*

The value of k is 0.158 and C_t was set equal to 0.0035. These values correspond to a threshold of apparent contrast $(N_1\text{-}N_2)/N_2$ change of approximately 0.002 of some contrast edge within a landscape and will usually evoke a just noticeable change. ***Furthermore, a change in extinction coefficient of approximately 5% will evoke a just noticeable change in most landscapes****"*[14] (emphasis added).

EPA states, *"... a 5 percent change in light extinction is approximately 0.5 deciviews"* and *"this is a natural breakpoint at which to set the exemption level, since visibility degradation may begin to be recognized by a human observer at this extinction level"* [15]. But information contained in the reference provided by EPA, does not support the acceptance of this threshold.

5.1 Basis for EPA Definition of JNC Threshold

There are significant technical issues regarding the EPA's JNC threshold. EPA has not provided a sufficient technical basis to justify a 5 percent change in light extinction being a JNC threshold for all Class I Areas. In fact, based on the technical literature, it appears that a 5 percent change in light extinction or a 0.5 deciview change being a JNC is only based on presumptions and is technically inconsistent with the assumption made regarding the development of the deciview visual range scale.

5.2 Use of the JNC Threshold for Video Monitors for Defining Visibility Impacts in Class Areas

Review of the literature on EPA's JNC threshold suggests that extensive modeling was conducted to justify the proposed 5 percent change in light extinction as a JNC threshold. However, no references regarding this work are provided in the NAPAP Report. A review of the

[14] National Acid Precipitation Assessment Program (NAPAP). Acid Deposition: State of the Science and Technology Report 24, Visibility: Existing and Historical Conditions-Causes and Effects, Washington, DC, 1991. See Appendix D. p.24-D2.
[15] Federal Register /Vol. 69, No. 87 40 CFR Part 51 Regional Haze Regulations and Guidelines for Best Available Retrofit Technology (BART) Determinations; Proposed Rule. Page 25194

information provided instead indicates that a 5 percent change in light extinction was based on the Quadratic Detection Model, proposed by Carlson and Cohen, and used to predict thresholds of perceived image sharpness in video type image displays[16]. While the theory used for defining a JNC threshold in a video monitor may be applicable to air quality visibility issues, neither EPA nor the NAPAP Report provide any supporting evidence that the JNC threshold in video monitors is applicable to determining changes in visual ranges in the atmosphere (over long sight paths).

5.3 Universal Applicability of JNC Over Long Sight Paths

The NAPAP reference raises several important questions regarding the JNC threshold over long sight paths. First, there is no clear definition of what the statement *"a change in extinction coefficient of approximately 5% will evoke a just noticeable change **in most landscapes**"* means (emphasis added). Second, it is also unclear how universally applicable this threshold could be over a large range of sight paths. This suggests that the establishment of a humanly perceivable JNC threshold may be dependant on the longest sight path within a Class I Area and that the establishment of a single JNC threshold might not be appropriate and, therefore, contrary to EPA's definition.

5.4 Basis for Deciview Visibility Unit of Measure

An additional reference provided by EPA regarding a human JNC threshold is an Atmospheric Environment paper written by Pitchford and Malm[17]. This paper outlines the concept of the deciview visibility unit of measure in which the authors conclude, based on what appears to be a sensitivity analysis, *"From this it seems **reasonable to presume** that a fractional change in extinction coefficient between 5 and 20 % would produce a JNC in a scene"* (emphasis added). The use of a presumptive sensitivity analysis to develop a JNC threshold is not appropriate since

[16] Carlson and Cohen. 1978. Image Descriptors for Displays: Visibility of Displayed Information. RCA Laboratories, Princeton, NJ.
[17] Pitchford M. L. and W. C. Malm, 1994 "Development and Applications of a Standard Visual Index" Atmospheric Environment Vol. 28, No. 5 pp. 1049-1054

it does not provide any documentation regarding what is a JNC over long sight paths or how universally applicable this is to varying sight paths. The authors also conclude *"a 1 to 2 dv change corresponds to a small, visibility perceptible change in a scene appearance* ***where the assumptions used in developing the deciview scale are met****"* (emphasis added). This translates to a change of 10 to 20 percent in extinction. Because a 1 to 2 deciview change is perceivable only if the assumptions used to develop the deciview scale are met, it is important to review the assumptions that were made in the development of the deciview scale because they define the limitations on universal applicability of the visibility unit of measure. Other deciview assumptions are:

1) Contrast is a good indicator of visibility. The apparent contrast of an element of a scene can be used to estimate whether the element can be perceived and, when it can be perceived, the apparent contrast can also be used to evaluate the visual quality of its appearance.
2) The magnitude of the change in apparent contrast of a distant terrain feature against the horizontal sky required for a JNC is proportional to the apparent contrast of the terrain feature.
3) The apparent contrast of a distant terrain feature against the horizontal sky is given by the following equation:

$$C=C_o \exp(-r B_{ext})$$

Where: C is the apparent contrast

C_o is the initial contrast

B_{ext} is the average extinction coefficient for the sight path

r is the distance to a distant terrain feature

The first assumption regarding contrast being an indicator of visibility is generally accepted.

Inherent in the second assumption is that, for a change to be noticeable, the magnitude of the change is proportional to the change in contrast as stated in the following equation.

$$\text{delta } C_{JNC} = L\ C$$

Where: L is a constant that depends on spatial frequency but not contrast

The work of Carlson and Cohen has shown that this equation is not generally considered valid, but may provide a reasonable approximation in viewing environments such as a view of a terrain feature against the horizontal sky[18]. As such, this assumption could be considered in development of a JNC threshold.

The third assumption is valid if the horizontal sky radiance has the same value at each end of the sight path. Further, it can be regarded as a restriction that the use of the deciview index or extinction applies to terrain features against the sky. In general, the use of the deciview index only applies to the special case **where the sight path is equal to the visual range**. This assumption is also applicable to the manner in which the 5 percent change in extinction was defined as a JNC threshold. This is a significant over simplification of the proposed JNC threshold.

In a review of the aforementioned Pitchford and Malm deciview scale, Richards indicated, " *For example, more than a 40 % change (more than 4 – dv change) in regional haze is required for the change to be perceptible in sight paths shorter than 20 % of the visual range."*[19] Richards also states that in some cases a 5 percent change in contrast can be perceivable but it is commonly assumed that features with only a 2 percent change in contrast can be perceived. Using this information, Richards shows that the Pitchford and Malm equations can be rewritten as follows:

For a 2 percent case

$$\text{delta } b_{JNC} = 0.4 / r$$

and a 5 percent case

$$\text{delta } b_{JNC} = 0.32 / r$$

[18] Carlson, C.R. and R.W. Cohen 1978 "Visibility of displayed information. Image descriptors for displays" RCA Laboratories, Princeton N.J.
[19] Richards, L.W., 1999,"Use of the Deciview Haze Index as an Indicator for Regional Haze", AWMA

These equations apply to sight paths of any length less than or equal to the visual range and give the value for delta b_{JNC} equal to those calculated by the Pitchford and Malm work when the sight path is equal to the visual range.

Based on the importance of the inclusion of sight path in the determination of the JNC, it seems that EPA should have incorporated this into the threshold determination and if this were done, a more robust measure of what is humanly perceivable could have been derived and would have resulted in a more defendable measure of "contribute" and "impair" than EPA has defined.

The incorporation of sight path would have required that the JNC threshold be site specific for each Class I Area and that individual states be required to develop their own JNC threshold for each Class I Area. Incorporation of this approach would have ensured that the JNC threshold would be based on the "best science".

5.5 Practical Perspective of the Deciview Assumptions

It is important to place the assumptions used by Pitchford and Malm into practical perspective. Figure 11 presents a comparison of the longest sight paths that can be drawn within 35 Class I Areas as well as the estimated lengths of the longest visual range.

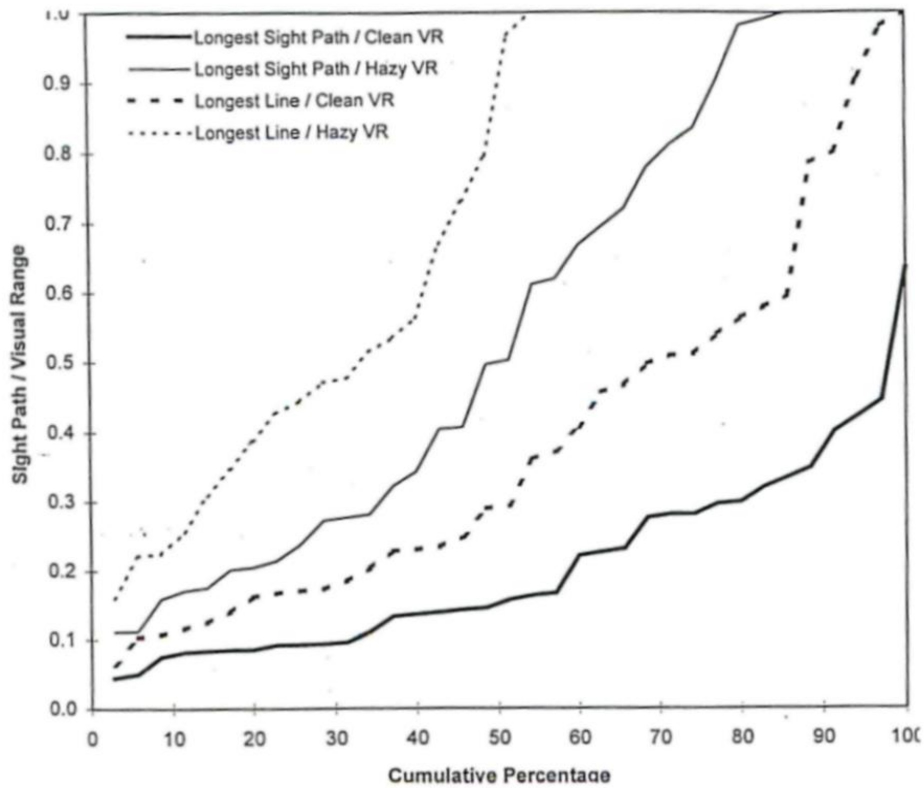


Figure 11. Comparison of Lengths of the Longest Lines for 35 National Parks and the Estimated Sight Path within these Parks[20]

The visual ranges were calculated from the average light extinction coefficient for the 20 percent of the days that were the least impaired (clean) as well as the 20 percent of the days that were the most impaired (hazy). A point on a line indicates the percentage of the parks that have a ratio equal to or smaller than the value at that point. Most ratios are less than 1 and therefore sight paths are typically shorter than the visual range and contrary to the assumptions used in the development of the deciview index. This indicates that for a vast number of Class I Areas, the basic assumption of the deciview calculation has not been met. Thus, assuming that the sight path is equal to the visual range simply adds a layer of unnecessary additional conservatism to

[20] Richards, L.W., 1999,"Use of the Deciview Haze Index as an Indicator for Regional Haze", AWMA

the calculation and results in mandating controls on sources that in reality have little contribution to visibility impairment.

Figures 12, 13 and 14 present the longest sight paths for the Bridger Wilderness, Mesa Verde National Park and Weminuche Wilderness PSD Class I areas. Table 2 presents comparison of the actual longest sight path for these areas and the background sight path assumed in FLAG. As indicated in this table the background sight path overstates the actual sight path by a large fraction and this assumption adds unnecessary conservatism to any AQRV visibility analysis.

Table 2
Comparison of Actual Sight Paths and FLAG Natural Background Sight Paths

PSD Class I Area	Maximum In-Park Line-of-Sight (km)	FLAG Average Natural Conditions Visual Range (km)
Bridger Wilderness Area	91	288
Mesa Verde National Park	15	273
Weminuche Wilderness Area	66	276

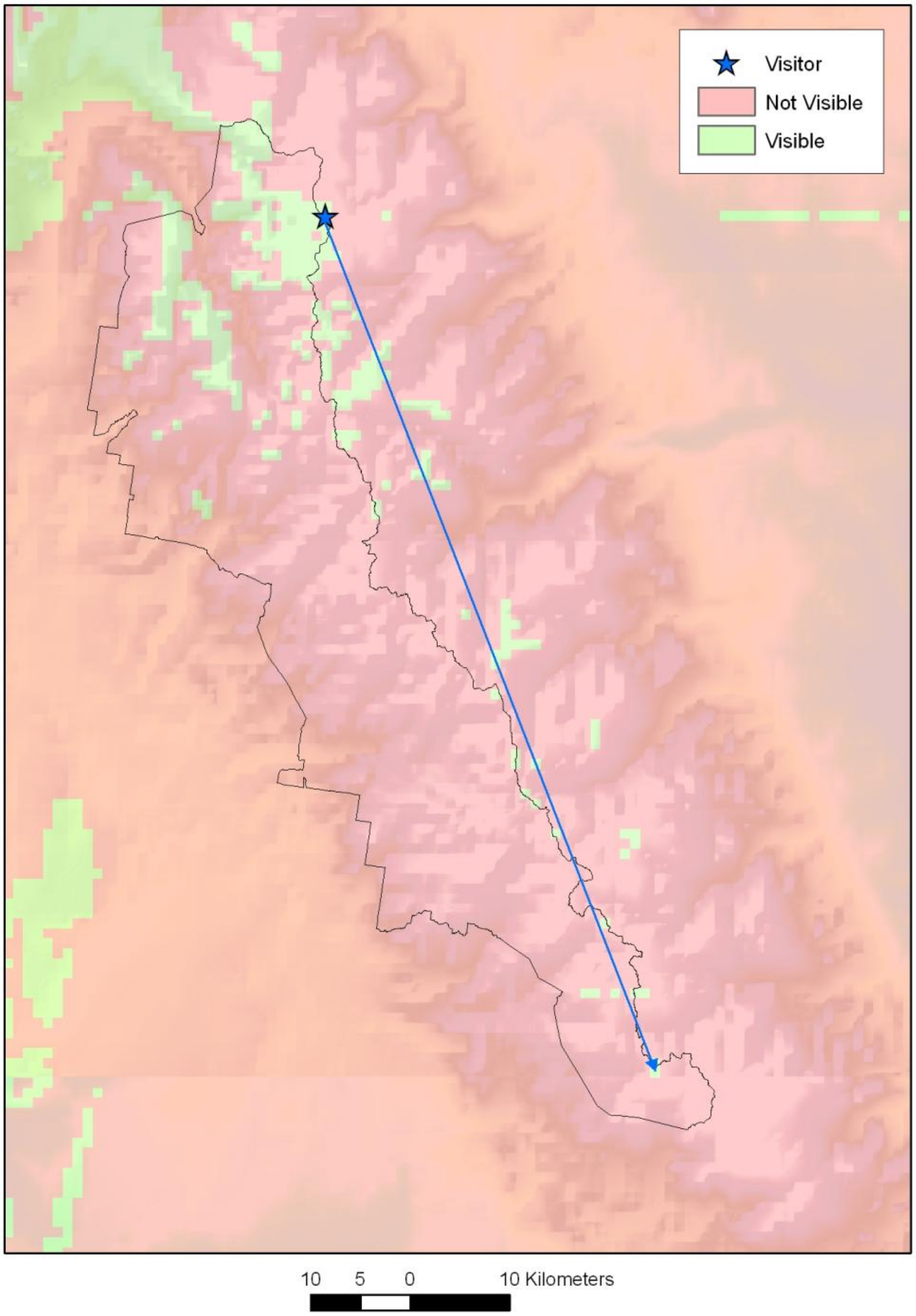


Figure 12. Longest Sight Path in the Bridger Wilderness Area

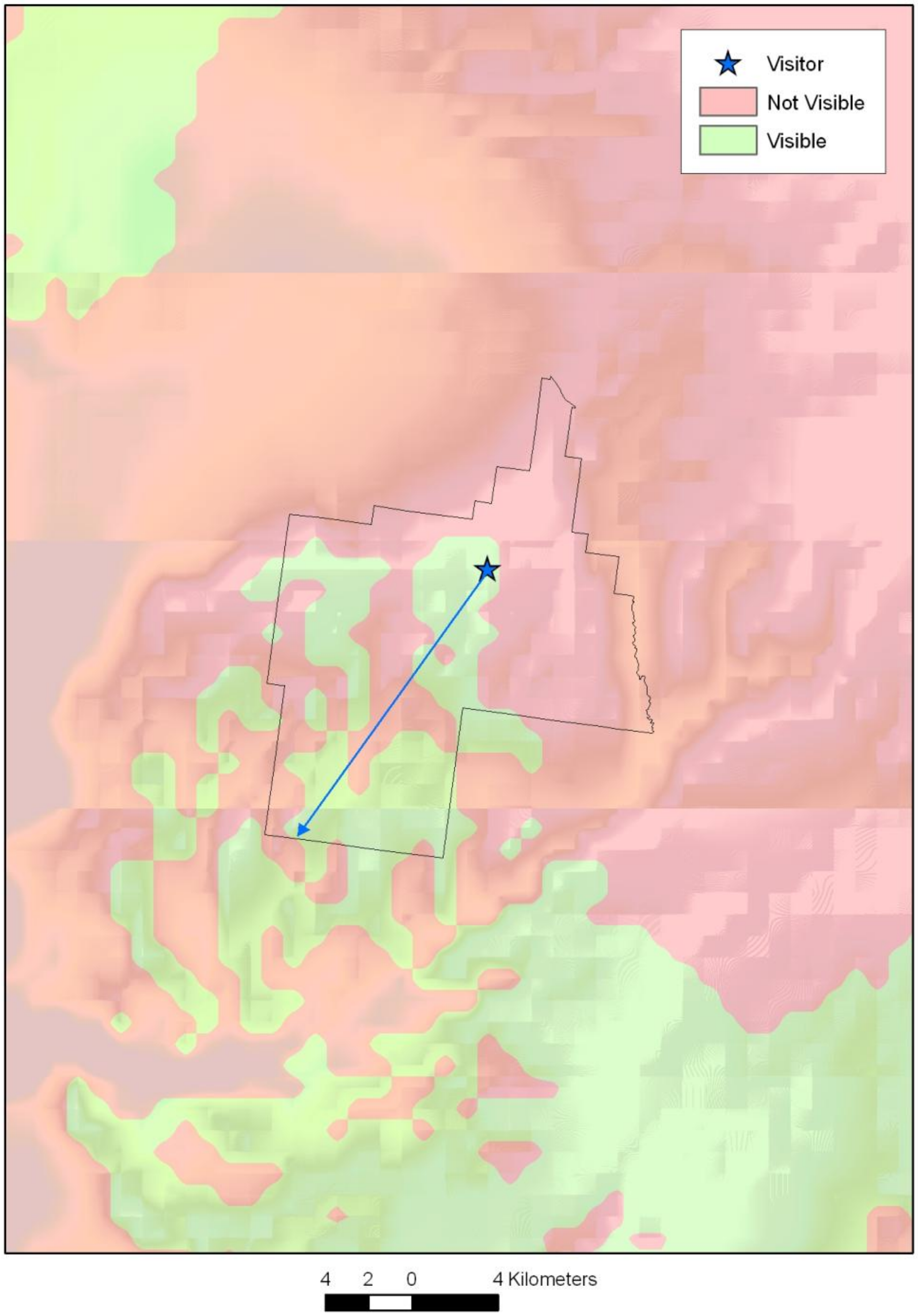


Figure 13. Longest Sight Path in the Mesa Verde National Park

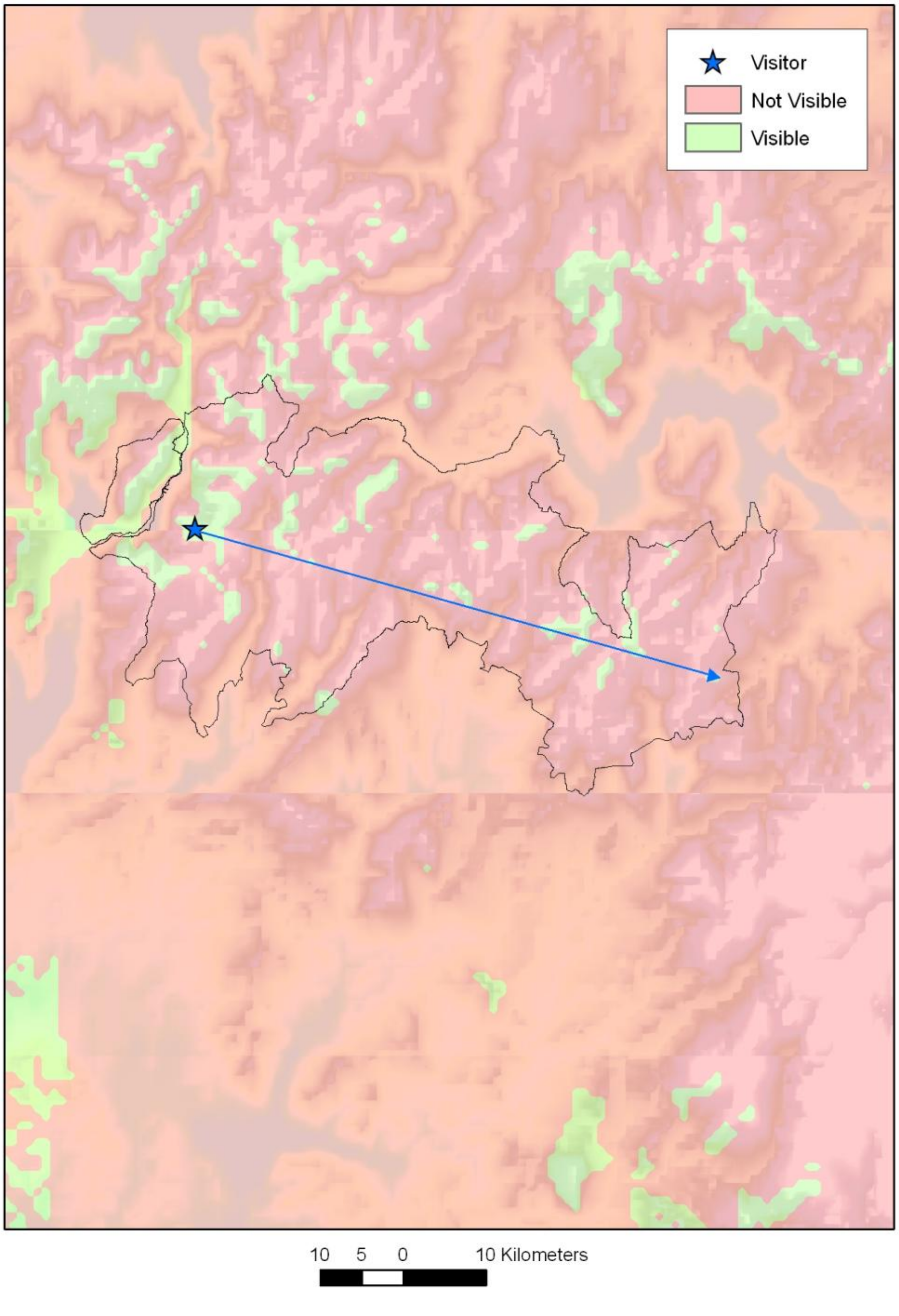


Figure 14. Longest Sight Path in the Weminuche Wilderness Area

6.0 OZONE

The approach that the FLMs have taken on ozone is inconsistent with the goals they established in the draft FLAG document that is to provide a consistent definable framework for conducting AQRV analyses. Rather, the approach outlined in the document is completely subjective in nature and provides arbitrary guidelines for additional mitigation that may result in no reduction in ozone concentrations in Class I Areas. For example, in Section 4a, **"***If the FLMs have evidence that ozone is adversely impacting an area they manage, they will recommend that additional emissions of ozone precursors are minimized until those adverse impacts are minimized.***"** This requirement is subjective in both identifying potential adverse ozone impacts as well as in establishing additional mitigation. In addition in Section 4e a "$Q/D \leq 10$" screening criteria, where Q is the sum of VOC and NO_x emissions in tons per year and D is the distance in kilometers from a source to the nearest Class I area, is proposed to determine whether or not a new source requires an ozone analysis. This screening criteria is also subjective and does not have any technical basis.

6.1 Quantification of Ozone Impacts

The FLM approach lacks any quantitative approach for addressing ozone impacts for new sources (quantification of new source impacts is the primary goal of FLAG) and therefore needs to be better defined in the document. However, it is inappropriate for the FLMs to define a methodology in isolation. Development of such an approach needs to be conducted in a technical public stakeholder process where all interested parties help develop the technical approach.

One significant issue with the FLM approach is that there is confusion regarding impacts from new and existing sources. All of the discussion related to ozone impacts is based on monitoring impacts of existing sources, not forecasting impacts for new sources. The logic presented in the Section 4a quote listed above is that if monitoring indicates vegetative damage, then any new source must be mitigated to a level defined by the FLMs. Such an analytical approach is inappropriate and may not result in any improvement in ozone levels. The document needs to include methodology on how impacts from proposed new sources should be conducted. As indicated above, requiring additional mitigation for new sources (based on subjective criteria and subjective source culpability) is not appropriate.

First, the FLMs or EPA need to define a de minimus emission level for new VOC and NO_x sources with respect to ozone. Proposed sources with emissions less than the identified de minimus emission level would not be subjected to additional review by the FLMs.

Second, for new emission sources in excess of the de minimus threshold, air quality analyses based on source apportionment results from previous photochemical modeling analyses could be used to identify the potential for additional ozone impacts. There are currently a number of such modeling studies underway that could be used as the starting point for regional air quality studies.

Third, there are cases for regional development projects for which conducting photochemical modeling are appropriate. The FLAG document should address when such analyses should be conducted. The FLMs, states and EPA must address the issue regarding new source development in the context of modeled exceedances from existing sources for the ozone standard. Given the regional nature of ozone (impacts from both local and distant sources), it is necessary for FLMs, states and EPA to define insignificant ozone impacts. This concept should be analogous to non-attainment NSR (if predicted impacts of a pollutant are above the standard, but the proposed source has insignificant impacts, the permit can still be granted).

Table 3 presents source apportionment modeling results from the Four Corners Early Action Compact analysis conducted by the States of New Mexico and Colorado[21]. As indicated by this table, the vast majority of the ozone impacts are from sources outside the region. Thus, if ozone

[21] ENVIRON, 2004, Air Quality Modeling Analysis for the San Juan Early Action Ozone Compact Maintenance for Growth and control Strategy

impacts were considered important in nearby Class I Areas, controlling oil and gas sources would have little impact on improving ozone in the region.

Table 3
Summary of Ozone Source Apportionment for June 30 2007
Model predictions are for 1-hour averages

Ignacio										
Sector	**Area**	**MV**	**Off Road**	**Oil and Gas**	**EGU**	**Non EGU**	**Biogenic**	**Initial Conditions**	**Boundary Conditions**	**Total**
San Juan	0.03	0.86	0.21	1.81	0.04	3.36	1.37			
Southern	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Southwest	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Southeast	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Northeast	0.00	0.16	0.05	0.00	0.00	0.02	0.24			
Northwest	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
NE NM	0.00	0.00	0.00	0.00	0.00	0.00	0.05			
Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Total (ppb)	**0.03**	**1.02**	**0.26**	**1.81**	**0.04**	**3.38**	**1.66**	**45.49**	**10.39**	**64.08**
Total (%)	**0.05**	**1.59**	**0.41**	**2.82**	**0.06**	**5.27**	**2.59**	**70.99**	**16.21**	

6.2 Mitigation Approach

The following statement is the basis for the FLMs focusing on NO_x control as a means of ozone mitigation. *"Information suggests that in areas where ozone formation is driven by VOC emissions, i.e., VOC-limited areas, VOC to NO_x ratios are less than 4:1. In VOC-limited areas, minimizing or reducing VOC emissions is the most effective means of limiting or lowering ozone concentrations. Conversely, in NO_x-limited areas, where VOC to NO_x ratios are greater than 15:1, controlling NO_x emissions is most effective. It is generally thought that most rural areas of the U.S. are NO_x-limited, most or all of the time, with the possible exception of the rural areas of southern California.*"

The first issue with this statement is that the FLMs provide no reference on the specified levels. Thus, it is not possible to verify that this information is applicable. The following figure is part of a photochemical box modeling analysis that was conducted for southwestern Wyoming[22]. The input to the model was ambient air concentrations that were measured during periods of high ozone. As indicated in Figure 15, reducing ambient NO_x concentrations results in higher ozone concentrations. It is inappropriate for the FLM to predetermine if an area is VOC or NO_x limited. Such a decision must be based on site-specific analysis of air quality emissions or concentrations in the area.

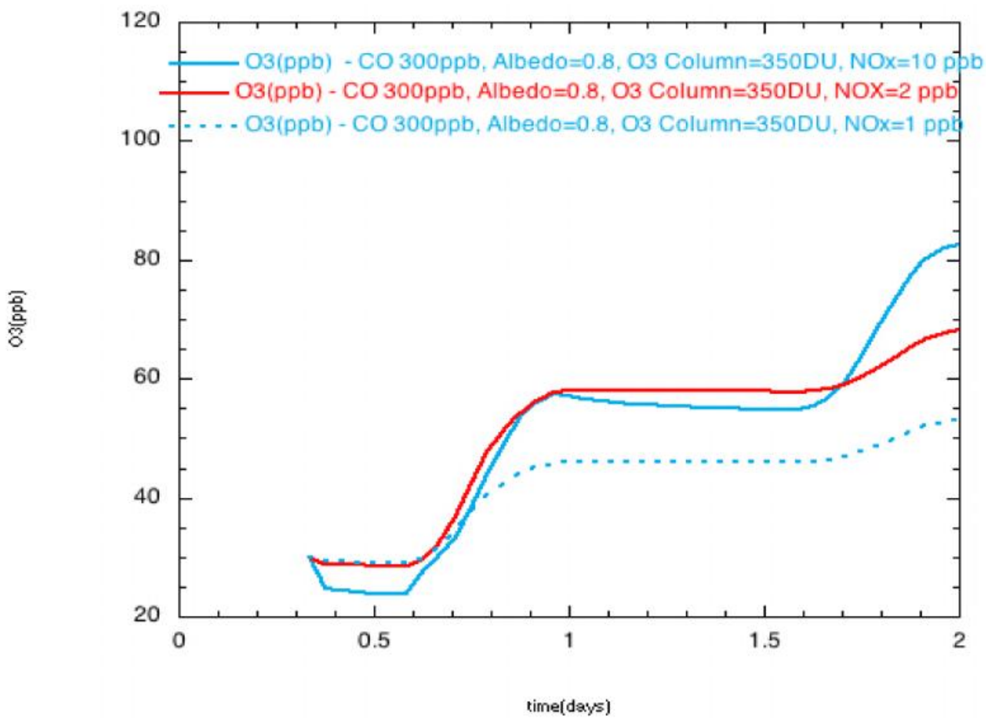


Figure 15. Sensitivity of model-calculated ozone to changes in NO_x mixing ratio. The red line corresponds to a high NO_x concentration (10 ppbv), the blue line to 2 ppbv of NO_x, and the dashed blue line to low NO_x (1 ppbv).

[22] Kotamarthi, V.R. and D.J. Holdridge, 2007. "Process-Scale Modeling of Elevated Wintertime Ozone in Wyoming", Work supported by BP America through U.S. Department of Energy contract DE-AC02-06CH11357 to Argonne National Laboratory